Vol. XX. OCTOBER, 1895. No. 10.

THE BOTANICAL GAZETTE

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[ISSUED OCTOBER 17.]

MADISON, WISCONSIN.
PUBLISHED BY THE EDITORS.

Tracy, Gibbs & Co., Printers, Madison, Wisconsin.

THE BOTANICAL GAZETTE

A Monthly Journal Embracing all Departments of Botanical Science.

ANNUAL SUBSCRIPTION, $3.00.

SINGLE NUMBERS, 30 CENTS.

The subscription price must be paid in advance. No numbers are sent after the expiration of the time paid for. No reduction is made to dealers or agents.

In Great Britain, 14 shillings.	In Germany, 14 marks.
Agent, WM. WESLEY & SON, 28, Essex st., Strand, London.	Agents, R. FRIEDLÆNDER & SOHN, Carlstrasse 11, Berlin, N. W. 6.

The prices named include postage.

Subscriptions and business correspondence should be addressed to the **BOTANICAL GAZETTE, MADISON, WIS.**; money orders and drafts should be made payable to the BOTANICAL GAZETTE.

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[Entered at the Post-office at Madison, Wis., as second-class postal matter.]

In the November number will appear:

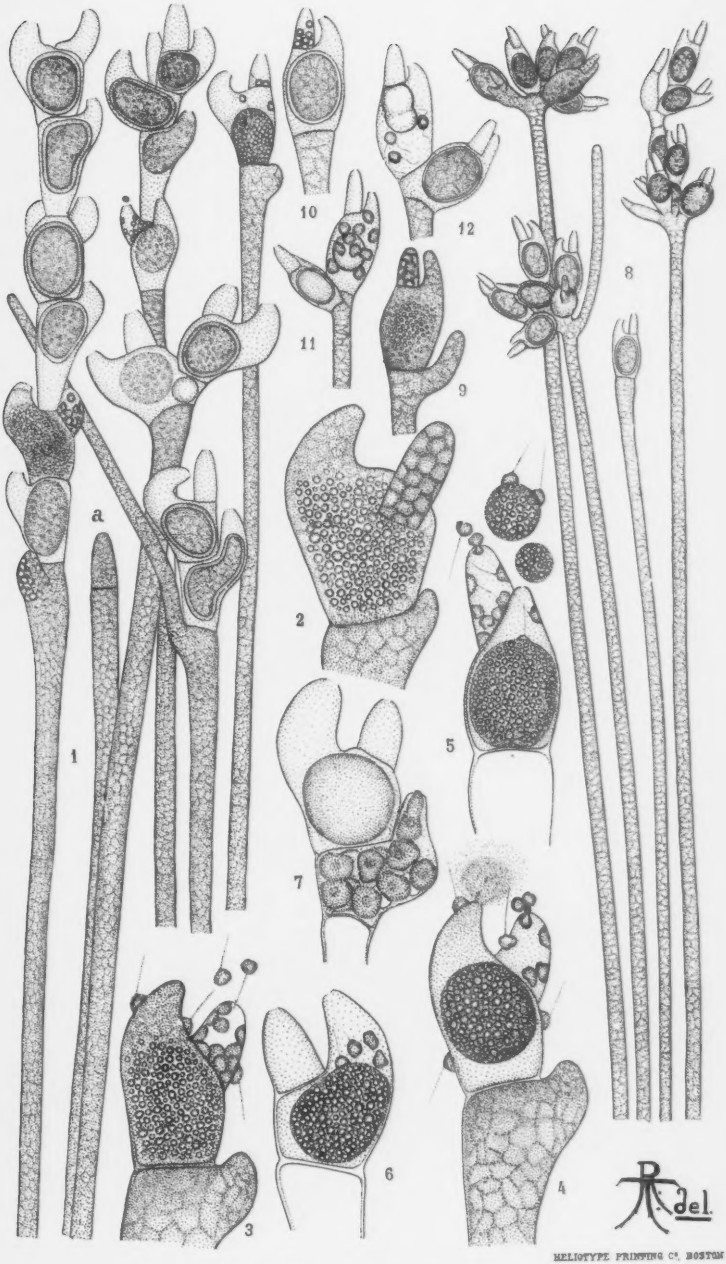
Recording apparatus for the study of the transpiration of plants, by ALBERT F. WOODS, *assistant in the Division of Veg. Physiol. and Path., Washington, D. C.*

Notes from my herbarium. IV, by WALTER DEANE, *Cambridge, Mass.*

New or peculiar aquatic fungi. II, by DR. ROLAND THAXTER, *Harvard University, Cambridge, Mass.*

Observations on the development of Uncinula spiralis, by B. T. GALLOWAY, *chief of the Division of Veg. Physiol. and Path., Washington, D. C.*

Noteworthy anatomical and physiological researches.



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THAXTER on AQUATIC FUNGI.

BOTANICAL GAZETTE

OCTOBER, 1895.

Contributions from the Cryptogamic Laboratory of Harvard University. XXVII.

New or peculiar aquatic fungi. 1. Monoblepharis.

ROLAND THAXTER.

WITH PLATE XXIX.

The following notes are derived from observations made by the writer during the past season on certain aquatic fungi which have come under his notice, and, although other occupations have made it impossible to study some of the forms enumerated as thoroughly as their peculiarities merit, it is hoped that the notes and illustrations given may have a certain interest from the fact that they deal with plants which are either wholly new or have been unobserved for twenty years or more since their original description.

MONOBLEPHARIS Cornu.

In a brief preliminary notice which appeared in the Bulletin de la Société Botanique,[1] Cornu first announced the discovery of a most remarkable and important genus of aquatic fungi which, on account of the fact that it was supposed to produce zoospores having a single cilium, was named by him "Monoblepharis." In the following year this writer's well-known "Monographie des Saprolégniées[2] was published, in which he describes and figures two species of the genus, *M. sphaerica* and *M. polymorpha*, referring incidentally to a third, *M. prolifera*, which is neither described nor figured. The last name subsequently remained a *nomen nudum* until the form was rediscovered and sufficiently described and figured by Reinsch, in an important paper published in 1878,[3] under

[1] **28:** 59. 1871.
[2] Annales des Sciences Nat. Bot. V. **15:** 82. 1872.
[3] Pringsheim's Jahrb. f. wiss. Bot. **11:** 293. —.

the name *Saprolegnia siliquaeformis*. In the following year a criticism of Reinsch's paper was published by Cornu in which he asserts that the *Saprolegnia siliquaeformis* of Reinsch is his own *Monoblepharis prolifera*. Since this time there have been no further contributions to our knowledge of the genus with the exception of certain further notes and figures by Cornu in Van Tieghem's Traité de Botanique. In 1892 A. Fischer[4] distinguished *Monoblepharis prolifera* Cornu under a new genus *Gonapodya*, placing the two genera by themselves in a family of Monoblepharidaceæ equal in value to the Saprolegniaceæ under the order Saprolegniinæ, in which he is followed a year later by Schroeter.[5]

Gonapodya being, however, apparently unrelated to Monoblepharis will be considered in a subsequent note and the order may be assumed to include the single genus from which it takes its name, of which but two species (*M. sphaerica* and *M. polymorpha*) have, up to the present time, been observed and described by Cornu alone as above stated.

The family owes its importance chiefly to the fact that among the whole group of Phycomycetes it presents the only instance in which a female cell or oosphere is fertilized through the agency of actively motile antherozoids. The striking resemblances which exist between its reproductive processes and those of algæ like Vaucheria or Œdogonium are too self-evident to need enumeration. To those who, like the writer, are unwilling to believe that the fungi form anything in the nature of a series derived like the series of Algæ from a common origin at its base, it has an especial interest; since it affords one of the strongest arguments in support of the theory which would view the fungi as a heterogeneous group of degenerate forms derived at different points from the different types of the algal series.

The species which have come under the writer's notice are four in number including *M. polymorpha*, and a second form related both to this species and to *M. sphaerica;* but like the former maturing its oospores outside the oogonium. The two remaining species which are considered in the present note, though closely allied to one another, are very distinct from either of the remaining forms, corresponding in the position of their antheridia to *M. polymorpha* while they resemble *M.*

[4]Rabh. Kryptogamenfl. Abth. I. 4: 378. 1892.
[5]Engler and Prantl, Natürl. Pflanzenfam. 93: 106. 1893.

sphaerica from the fact that they mature their oospores within the oogonium. Although the development of these forms confirms in most respects the observations of Cornu, a brief account of their life history may not be superfluous.

The hyphæ of all the species of Monoblepharis are almost always recognizable at a glance from their elegant and characteristic vacuolation, the protoplasm forming a network of finely granular strands the meshes of which are often remarkably regular in size and form, while in these strands the coarser granules may be seen moving with considerable rapidity. Thus in the smaller forms the strands commonly cross the filament nearly at right angles, and one seldom sees the more or less longitudinal arrangement of the granules so often characteristic of the Saprolegniaceæ. The fertile hyphæ may arise in considerable numbers from a more or less well developed creeping and branching base which is fixed to the substratum by terminal rhizoidal attachments, and in the two species under consideration, which may be called *M. insignis* and *M. fasciculata* respectively, are rigid in habit, tapering but slightly, rarely branched and without septa except in connection with the reproductive organs. According to Cornu the hyphæ, unlike those of other Phycomycetes, give no test for cellulose; but the writer does not feel as yet fully satisfied with his own observations on this point.

The antheridia in these species are invariably terminal organs, either at the tips of the main axes or of lateral outgrowths from them, while the oogonia are always intercalary. In *M. insignis*, for example, a terminal more or less conical cell is separated by a septum to form the first antheridium (fig. 1*a*). The portion of the hypha just below this septum then enlarges producing a lateral projection (the "neck" of the oogonium), the young oogonium thus formed separating itself by a second septum from the hypha below it. The antheridium thus appears to be borne directly upon the oogonium. In the species just mentioned, after the formation of the first oogonium, a lateral branch begins to form just below it (fig. 3), the tip of which is cut off as before to form a second antheridium, while its base and the upper part of the hypha below it enlarge together to form a new oogonium from which a neck is laterally developed as before. The whole is then separated from the unmodified axis below by an additional septum, so that as a result two oogonia are superposed

at the tip of the filament on each of which is inserted an antheridium. The same process may be repeated until as many as eight superposed oogonia terminate the fertile hypha. In *M. insignis*, however, oogonia frequently occur in connection with which no antheridium has been formed. In *M. fasciculata* the process is essentially the same; the fertile axis in this species usually producing several terminal branchlets which become converted in a similar fashion into superposed oogonia, in this instance always associated with antheridia. While the oogonium is developing and before it is fully mature, the contents of the antheridium begin to divide into a variable number of antherozoids (in *M. insignis* often at least thirty-two) and after they are fully formed the tip of the antheridium becomes perforate and the male elements begin to escape slowly, emerging through an at first very small orifice, and dragging behind them a single slender cilium. Several antherozoids usually succeed one another in making their exit, collecting near the tip of the antheridium and going through continuous amoeboid changes of form. After about five minutes the cilia begin to vibrate and the antherozoids swim off with a rapid jerky motion. Meanwhile the remaining antherozoids creep about on the inner wall of the partly emptied antheridium escaping at irregular intervals singly, or several in succession, through the orifice which finally becomes so greatly enlarged that the last antherozoids are able to make their exit without any considerable change of form. Cornu states that both the zoospores and antherozoids make their escape in a quite characteristic fashion, each drawing out its successor from the antheridium by means of its cilium, but this seems certainly not to be the case, the exit being accomplished by means of amoeboid movements, each antherozoid escaping independently of those which have gone before it.

The free swimming antherozoids are nearly spherical or broadly oval in form, with a few refractive granules and a large central nucleus. They move with considerable rapidity, the cilium being directed backwards, and may often be seen to come suddenly to rest on an unfertilized oogonium over which they begin at once to creep with an amoeboid motion.

When the antheridium has become partially emptied, the escaping antherozoids do not all swim off in the surrounding

water; but some of them at least begin to creep with amoeboid movements over the surface of the antheridium and thence over the oogonium, the single cilium projecting outward somewhat obliquely. In this way they may take journeys of considerable length, creeping around the oogonium, down to the hypha which bears it, and then back again; sometimes disengaging themselves and swimming away as already described.

In the meantime, usually after about one-third of the antherozoids have made their escape, the oogonium, having reached maturity, opens. Before this occurs the main body of the organ is filled by a mass of very coarsely granular protoplasm, its projecting neck being filled with a more finely granular contents which also extends around the coarser mass. The dehiscence of the oogonium is effected by pressure from within, a rupture occurring at the tip of the "neck," through which a large amount of the finely granular contents is discharged with considerable force (fig. 4). This discharge is occasionally so violent that a small amount of the coarsely granular content is also discharged, which, instead of becoming at once dissipated in the surrounding water like the finely granular protoplasm, coheres in aspherical mass and exercises an attractive influence on passing antherozoids (fig. 5). After the dehiscence of the oogonium its remaining contents contract into an oosphere of definite contour (figs. 4, 5) which is then ready for fertilization. The antherozoids soon creep up over the neck and through the opening at its tip, making their way into the oogonium and moving along its inner wall down to the oosphere. As many as eight antherozoids have been seen in a single oogonium; but only one appears to fuse with the oosphere in the fashion described by Cornu, the cilium projecting upwards and the body slowly sinking into the substance of the oosphere (fig. 5). In some instances an antherozoid which has just escaped from the antheridium may be seen to stretch across to the adjacent tip of the oogonium into which it makes its entrance without the usual preliminary perambulations. Fertilization having been thus accomplished, the oospore surrounds itself with a smooth thick wall, and, in both the species under consideration, remains within the oogonium at maturity. Although the oospores have been kept in water for several weeks, no signs of germination have been as yet observed; but it seems more than prob-

able that this takes place by means of zoospores of the usual type.

The zoospores, which are very rarely produced in *M. insignis* but are found more commonly in *M. fasciculata*, are more than twice as large as the antherozoids. According to Cornu the zoospores resemble the antherozoids in all respects except in size; but, although the writer has not thoroughly satisfied himself on this point in his examination of fresh material, stained preparations of the zoosporangia of *M. fasciculata* show distinctly two cilia on zoospores which had not as yet escaped when the preparation was made (fig. 12). In both of the present species, as is also frequently the case in *M. polymorpha*, the zoosporangia resemble the oogonia in all respects (figs. 7, 11, 12) and are formed in exactly the same way, usually in connection with an antheridium. The long clavate sporangia, however, which are also characteristic of *M. polymorpha*, have not been observed in either of the new species. After the escape of the zoospores a large oil globule always remains within the sporangium. Further details concerning *M. polymorpha* and the additional species above referred to are withheld for the present. The two remaining forms may be characterized as follows:

Monoblepharis insignis, nov. sp.—Hyphæ straight, rigid, hyaline or very pale reddish brown, nearly cylindrical, rarely branched, 1.5–2.5^{mm} in length by 8–15μ in diameter. Antheridia broad, subconical to subcylindrical, straight or slightly divergent, the rounded tip often bent slightly inwards, nearly symmetrical or often with the base irregularly protruded on its inner side. Antherozoids numerous (about 24–32), 1-ciliate. Oospores maturing within the oogonium, smooth, pale amber-brown, spherical to long oblong or irregular in outline, 30–45 × 22–33μ. Oogonia single or several superposed at the tips of the hyphæ, irregular in form. Zoosporangia rare, similar to the oogonia; zoospores 2-ciliate (?), about 10–12μ in diameter.

On submerged sticks in pools and ditches, Weston and Medford, Mass., and Kittery Point, Maine.

This species appears not to be uncommon and is conspicuous from its large size and striking appearance. It was found growing with Œdogonium and other forms in the situations mentioned, and on account of its greater dimensions is better adapted than either of the much smaller remaining species to

demonstrate the characteristic processes of reproduction. It varies considerably in the size of its filaments, as well as in the size and form of its oogonia and oospores, the latter often following the contour of irregular oogonia in which they may have been formed.

Monoblepharis fasciculata, nov. sp.—Hyphæ straight, rigid, cylindrical, simple or rarely branched except at the tips, 1–2^{mm} long by 6μ in diameter. Antheridia narrow, tapering slightly, straight, not divergent. Antherozoids about sixteen in an antheridium, 3μ in diameter. Oogonia evenly oval oblong or elliptical, the neck small and prominent, usually shorter than the antheridium which is always present, single and terminal or borne superposed on short crowded branches from the tips of the fertile hyphæ. Oospores more or less regularly oval oblong or elliptical, smooth, pale amber-brown, maturing within the oogonium, 22 × 18μ. Zoosporangia like the oogonia, bearing antheridia: the zoospores 2-ciliate, about 5–6μ in diameter.

On submerged sticks with the last. Weston and Medford, Mass.

This species, which seems to be much more rare than the preceding, has been found but twice in the localities mentioned. It seems to be abundantly distinguished from the last by its constantly smaller size and the greater regularity and different form of its sexual organs and spores, as well as by its fasciculate habit.

Harvard University.

Explanation of Plate XXIX.

Monoblepharis insignis Thaxter.

Fig. 1. Group of fertile hyphæ bearing oogonia terminally. *a*, hypha from the tip of which an antheridium has been cut off.

Fig. 2. Oogonium and antheridium neither of which have yet opened. A new oogonium beginning to form below the first.

Fig. 3. An oogonium still closed, over which two antherozoids from the partly emptied antheridium are creeping.

Fig. 4. The same ten minutes later; the oogonium just opened and discharging the finely granular protoplasm at its tip; the coarsely granular part having contracted to form the oosphere: four antherozoids still remain within the antheridium, one of which is just escaping.

Fig. 5. Oogonium from which a portion of the coarsely granular contents has been discharged in two masses on the larger of which two antherozoids are creeping: within the oogonium are two antherozoids one of which has almost fused with the oosphere.

Fig. 6. An empty antheridium and an oogonium which has been entered by four antherozoids.

Fig. 7. An oogonium in which fertilization has taken place; below it a zoosporangium from which the zoospores are just ready to escape.

Monoblepharis fasciculata Thaxter.

Fig. 8. Group of fertile hyphæ with oogonia at their tips.

Fig. 9. Unopened oogonium and antheridium below which a branch is forming.

Fig. 10. Oogonium with mature oospore.

Fig. 11. Oogonium and zoosporangium from which a few zoospores have escaped: the sporangium terminated by an antheridium.

Fig. 12. A similar specimen in which three zoospores still remain in the oogonium together with a large residual oil mass.

*** NOTE —Figures 1 and 8 are drawn with Zeiss obj. A, oc. 4. The remainder with obj. D, oc. 4.

The regulatory formation of mechanical tissue.[1]

FREDERICK C. NEWCOMBE.

The prevalent notion of the influences which affect the progress on growth is doubtless that which one finds in the manuals on plant physiology most in use at the present day. In these manuals growth is set forth as governed largely by mechanical forces; by increase and decrease of pressure, and this pressure not acting as a stimulus but as a mechanical force. In Sachs' "Lehrbuch" of 1874 and again in his "Vorlesungen" of 1882 is a detailed elaboration of his mechanical theory; Vines' "Physiology of Plants" (1886) follows Sachs closely; while Pfeffer's "Physiologie" (1881) shows a little breaking away from the theory of Sachs, in that he gives contact as a stimulus to the formation of tissue, a phenomenon therefore of irritability.

It may not be devoid of interest to review briefly the steps by which this mechanical theory of growth gained its hold in the minds of botanists.

As the result of his well-known experiments, described in 1803, Knight[2] expressed the belief that the cortex of trees by its pressure exerted a restraining influence on growth in diameter, and that any means which reduced this pressure, such as the swaying by the wind, would allow a greater flow of nutritive fluid to the place and hence promote growth.

In 1859, Hofmeister[3] established the fact of interacting tissue tensions in a longitudal direction in growing plant organs.

Kraus,[4] in 1867, followed up the work of Hofmeister and discovered transverse tissue tension. Among his conclusions is this: that the curvatures due to geotropism, heliotropism, shaking by storms, and so forth, are accompanied by an excessive growth on the convex side, this excentricity of growth

[1]Read before Section G of the A. A. A. S. at the Brooklyn meeting, August 1894.

[2]Knight, Philos. Trans. Roy. Soc. Lond. —: 280–3. 1803.

[3]Hofmeister, Ueber die Beugung saftreicher Pflanzentheile durch Erschütterung. Ber. d. k. sächs. Gesell. d. Wiss. —: 194. 1859.

[4]Kraus, Die Gewebespannung des Stammes und ihre Folgen. Bot. Zeit. **25**: 105. 1867.

being caused by the flow thitherward of nutritive fluid, made possible by the reduction of tension on the convex side.

It will readily be seen that while Knight assumed tension of tissues to be a controlling factor in the growth in diameter of trees, Kraus extended this causal relation to all kinds of increase of tissue. It remained now for that master-builder, Sachs, in the first edition of his Lehrbuch, in 1868, out of the material furnished by his pupil Kraus, by Hofmeister, and by Knight, to construct the framework of a mechanical theory of growth, which he subsequently elaborated in his later manuals, after the researches of de Vries and Detlefsen.

De Vries,[5] in the period from 1872 to 1876, had experimented in increasing and decreasing the pressure of the cortex of trees by winding about stems ligatures of twine in the first case, and by making longitudinal slits in the cortex in the second case. With his ligatures he obtained, so he believed, autumn xylem in the spring time; and by slitting he claimed to produce spring xylem in the autumn. His conclusion is obvious: cortical pressure must be the cause of the formation of annual rings.

Detlefsen,[6] another pupil of Sachs, published in 1881 his observations and deductions on excentric growth, and starting with the premises that all expansion of cells is due to the hydrostatic pressure of the cell-contents and that any external resistance to this internal pressure would diminish the effectiveness of the hydrostatic pressure, he drew the conclusion that the amount of growth was determined solely by the differences between these two forces. Thus he accounted for all excentricities of growth in stems and roots of woody plants according to the increase or decrease of the cortical pressure. Thus branches of trees that extend horizontally should show the more tissue below; and curving branches should show the greatest formation of tissue on the concave side, since during secondary growth a longitudinally concave cortex has its tension reduced, but a longitudinally convex increased.

Bringing together in small space the chief observations on

[5] De Vries, Flora —: 241. 1872; —: 97. 1875: —: 2. 1876.–De l'influence de la pression du liber sur la structure des couches ligneuses annuelles. Extrait d. Archives Neerlandaises **11**: —. 1876.

[6] Detlefsen, Versuch einer mechanischen Erklärung des excentrischen Dickenwachsthum verholzter Achsen und Wurzeln. Arbeit. d. bot. Inst. in Würzburg **2**: 670–87.

which Sachs and his school built their theory, we have the following eight statements, the truth of the last two of which is not without exceptions:

1. Between all growing tissues both longitudinal and transverse tensions are present, the outermost tissues seeking to contract while the innermost are seeking to expand.

2. Swaying of a plant promotes growth from the cambium.

3. Ligatures about woody stems decrease the number and size of the xylem elements.

4. Slitting the cortex longitudinally promotes growth from the cambium.

5. Abrading the dead part of bark promotes growth from the cambium (Knight[7]).

6. Normal clefts in the bark of trees deepen in the early spring.

7. Branches and roots of trees show excentricity of growth and the greatest growth is on the lower side, or when flexed on the concave side.

8. In the curving of stems due to geotropism, heliotropism, etc., the greatest growth in thickness is on the convex side.

Granting for the moment that all of the foregoing statements are facts, it is rather surprising that the mechanical theory of growth could have gained such general credence when two of its vital supports were pure assumptions. In the first place it was necessary to assume that extension of cells is but the stretching of hydrostatic pressure from turgidity; and in the second place, that the resistance offered by the cortex is great enough to control the amount and direction of cambium growth.

In 1884 Krabbe published a research which showed the incorrectness of the second assumption, and last year Pfeffer showed the untenableness of the first.

Krabbe[8] measured the compressing force of the cortex of many trees finding it to be always less than one atmosphere. Its increase of pressure from spring to autumn is never more than a fraction of one atmosphere while in many trees the increase is hardly to be measured.

By using a ligature with graduated weight this botanist

[7] Knight l. c.

[8] Krabbe, Ueber das Wachsthum des Verdickungsringes und der jungen Holzzellen. Abhl. d. k. Akad. d. Wissensch. Berlin. 1884.

found that to check the growth of the cambium or to alter the size of cells required a pressure of three to five atmospheres, and from twelve to fifteen atmospheres to stop all growth. The pressure of the cortex must be, he concluded, from three to five times what it actually is to influence growth.

Thus the pressure of the cortex of woody trees is shown to exert little or no influence on the growth of the cambium; and this assumed support for the mechanical theory falls. With it also falls the time honored explanation of the cause of annual rings.

That the first assumption in support of the mechanical theory of growth—that extension is mere stretching—does not rest upon fact was demonstrated by Pfeffer.[9]

This author by an ingenious method was able to determine that cell membranes will extend till they feel no internal stretching force. Now if extension were the result of stretching alone, this condition could not be brought about, for the membrane would then be always in a state of tension.

If now growth is not controlled in a merely mechanical way by the pressure of tissue, we must look for some other explanation. Without attempting a discussion of the broad subject of growth, it has been and can be shown that growth especially of mechanical tissues is very often the result of self-regulation. It is true that the last statement does not propose the real cause; it is a confession of ignorance. But it removes the growth referred to from a mechanical phenomenon to one of irritability. This is the argument which I am making.

Let us now in the light of what has last been said examine some of the phenomena on which the founders of the mechanical theory based their argument, not forgetting however that the falsity of the theory has already been shown.

De Vries' experiments in placing ligatures about branches of trees gave the effect of unnatural pressure, not at all comparable with normal cortical pressure, and produced in the spring time, not autumn wood, as he said, but a deformed growth with smaller cells than in normal spring wood and with thinner walls than in normal autumn wood. There can be no doubt of the truth of this statement, for all of Krabbe's

[9] Pfeffer, Druck- und Arbeitsleistung. Abhandl. d. k. sächs. Gesells. d. Wiss. **20**: —. 1893.

results in similar experiments on trees as well as mine on several herbaceous and shrubby plants point to the same conclusion. Knight's result on removing the outer dead part of the bark and de Vries' on making longitudinal slits in the cortex of trees should be referred to irritability and border closely upon regulatory action. Krabbe showed conclusively that the xylem formed subsequently to slitting in the autumn is not spring wood as de Vries thought. It is a response made to the injury of the knife.

The excentricity of branches and roots considered by Kraus and made much of by Detlefsen does not conform to the rules laid down by these two authors. I have found that the strongest development of tissue is often present on the convex side, but often also on the concave side. *Gladiolus communis* is an example of a plant forming an excess of tissue on the convex side of a geotropic curvature of the stalk, while *Ailanthus glandulosus* Desf. furnishes an example of excessive growth on the concave side. Detlefsen stated that horizontal branches have the greatest development on the lower side. In the Quince (*Pirus cydonia*) I have found it greatest on the upper side. Moreover a branch that in part of its extent is convex upward, and, farther out, convex in the opposite direction, does not change its excentricity with the change of curvature. If this statement does not hold true for all plants, it does for many, as my own observations have convinced me. According to Detlefsen's rules, the buttresses which extend on the trunk of a tree from the base of the branches downward and from the roots upward ought to reverse their position.

If we refer these variations to phenomena of regulation, we have a theory that is tenable; for one plant may regulate in one way and another in another way.

The formation of a larger amount of mechanical tissue under the stimulus of swaying agrees well with the notion of regulatory formation. What better illustration could be desired? What greater need of strengthening itself could a plant feel?

Another case of regulatory growth is furnished by the behavior of climbing organs as determined by Darwin[10] and by Treub.[11] Cause such an organ to grow free from contact

[10] Darwin, Climbing Plants 48, 50, 51. 1876.
[11] Treub, Ann. du Jard. Bot. de Buitenzorg **2:** —. 1882.

and it remains weak. Mere contact with a solid body, however, calls forth a great development of strengthening tissue, which increases still more when the organ begins to feel the weight of the stem which it supports. The first strengthening tissue is here laid down as a response to contact; its increase is the regulatory response of the plant to the strain which it feels. Increase artificially the strain on the suspending organ and by regulation it will increase enormously its mechanical tissue, as I have had an opportunity to observe by examining the material prepared by Herr von Derschau, the description of which is soon to be published.

Similar results were obtained by Hegler[12] when he subjected stems and petioles to a pulling force. The petioles of a certain plant, for instance, in their normal condition, broke when subjected to a pull of 700^{g}; they were given for five days a pull of 500^{g}, and then broke at 1,600^{g}; others, pulled for five days by 500^{g}, were then pulled by weights of 1,200^{g} for five days longer, and then broke at a strain of 6,500^{g}. In ten days these petioles had increased their tensile strength fivefold. The strengthening was brought about in some plants by the development of collenchyma or sclerenchyma in the cortex, in others by the increase of the hard bast, in others by a greater growth of xylem, and still in others by a combination of two or more of these methods.

Corresponding results to those of Hegler I have recently obtained in the roots of young plants of *Helianthus annuus* and *Cucurbita pepo*, by attaching to the plants weights suspended over pulleys. In these experiments not only was the tissue strengthened, but the roots grew with a larger diameter than normally.

Thus far the attempt has been made to show that when an unusually heavy stress has been laid upon the plant, the plant responds by increasing the mechanical tissue. But if the plant be a self-regulatory organism, it might be expected that when the normal stress is reduced, the plant would form less than the normal amount of mechanical tissue. And the surmise has been proven to accord with the fact, first by the experiments of Knight ninety years ago, when he prevented the swaying of young trees in the wind by fastening them to

[12] Pfeffer reported these experiments as, R. Hegler's Untersuchungen über Einfluss von Zugkraft. Ber d. k. sächs. Geselsch. d. Wissensch. December, 1891.

stakes, and secondly, by the results which I have obtained by enclosing internodes of stems in plaster casts.

A general result in all my experiments, performed on scores of plants, embracing twenty-five species and a dozen genera, is the lack of the development of the mechanical tissue. The casts employed were from 3^{cm} to 5^{cm} in length, and thus a segment of the stem was freed from the most of the strain to which it would normally be subjected. There could be no lateral swaying, nor could the confined segment feel the full weight of the stem above. It is, of course, true that with an envelope of plaster, growth must soon be brought to a standstill by mechanical means, and therefore that less than the normal amount of supporting tissue could be formed. But that the lack of formation of mechanical tissue within the enclosed segments was not due merely to mechanical causes will appear from the two following reasons: In the first place, the young cells of the pith, of the collenchyma in the cortex, of the hard bast, and of the xylem that were formed before the casts were applied, did not, well within the casts, reach their normal thickness of wall. In the second place, corresponding tissues within but near the limits of the casts became thicker-walled than normally. Thus we have, at two places within the same cast, tissues in the one case, where there is little or no external stress, remaining abnormally thin-walled, but in the other case, where there is great stress, becoming abnormally thick-walled. This abnormal increase in the thickness of membranes in the region of the limits of cast is worthy of more than passing notice. It must be at the limits of the plaster envelopes that these plants felt the greatest strains from lateral swaying by the wind and from supporting the stem, as the breaking of several of them by the wind demonstrated. The thickening of membranes was always greatest just at the surface of the casts, and from that level it decreased both upward and downward, extending into the cast for a distance of a centimeter. The contrast was very striking; within the distance of a centimeter one could pass from a cross-section composed wholly of thin walls to one composed mostly of unusually thick-walled elements. All kinds of tissue took part in this great development, but especially the pith and cortex, since the production of new cells from the cambium was mostly prevented by the mechanical conditions. I see no way of explaining the results of these

experiments except as regulatory phenomena. Try the different hypotheses of pressure, tension of tissues, relation between size of cells and thickness of membrane, and so forth, and none of them is satisfactory.

There is no claim made here that all growth of mechanical tissue is regulated by stress. It is influenced probably by transpiration, as the researches of Kohl[1 2] seem to indicate, and there is doubtless also an hereditary factor.

There is yet one feature to be added to the subject of regulatory growth. In my experiments, *Vicia faba* and *Melianthus major*, after growing in casts for several weeks, were released, and then showed a great constriction at the place where the growth had been confined. Within three or four weeks this constriction had entirely disappeared. Microscopical examination showed that, since the removal of the cast, there had been in all the plants an excessive development from the cambium, in the place of constriction, reaching in one case 40 per cent. to 50 per cent. more xylem elements in the abnormal segment than in the normal parts, above and below it. On the removal of the casts the weak segments felt suddenly the full weight of the stem. They responded by building a sufficiency of supporting tissue. There is reason, too, why there should have been more than the normal amount formed. The plaster was laid about these stems while the pith was still expanding, and the vascular zone moving outward from the center. The cast checked this movement, and by subsequent development within the rigid envelope, the supporting xylem cylinder was fixed nearer the center than normally. When released from the confinement, a greater radial thickness of mechanical tissue was needed in the narrower cylinder than in the normal cylinder to give the same degree of strength.

By the expression "regulatory growth," we do not come to the actual means or to the specific stimulus for that growth. We may say that the plant has the ability to respond to stress, but the notion *stress* is complex, and will doubtless by future research be subdivided. But this much seems certain: The formation of such growths as have been recounted in this paper is no longer to be explained as simple mechanics, but rather as a member of the increasing number of phenomena of irritability.

University of Michigan.

[1 2] Kohl, Die Transpiration der Pflanzen. Braunschweig. 1884.

Synopsis of North American Amaranthaceæ. IV.

EDWIN B. ULINE AND WM. L. BRAY.

ALTERNANTHERA Forsk. Fl. Ægypt. Arab. 28. 1775.

Telanthera R. Br. (excl. Lithophila Sw.) Prodr. Fl. Nov. Holl. 1: 417. 1810.

Mogiphanes Mart. Nov. Gen. et Sp. 2: 29. *pl. 129, 134.* 1826.

Plant mostly herbaceous, very variable in habit, with flowers clustered in dense terminal heads (as in *Gomphrena*) or axillary (as in *Cladothrix*), usually inconspicuous bracts, five free often unequal sepals, two to five stamens (five in ours) coalescent into a tube, alternating above with the staminodia, which are entire, pointed, and sometimes much reduced, or wider and more or less laciniate, with an ovate or sometimes obcordate compressed slightly winged ovary, and capitate stigma.

**Staminodia simple.*

1. A. REPENS (L.) Kuntze Rev. Gen. Pl. 540. 1891.

Achyranthes repens L. Sp. Pl. 1: 205. 1753.

Alternanthera Achyrantha R. Br. l. c. 1810.

Stem prostrate, freely branching and forking, pubescent, 15 to 50^{cm} long: leaves glabrate, orbicular to ovate, narrowed into a short petiole: glomerules axillary: flower slightly compressed: sepals lanceolate, with prominent median nerve, spiny-pointed, strongly unequal, the two short ones thickly pubescent with barbed hairs, fuscous: sterile filaments nearly equaling the fertile ones: utricle ovate, slightly compressed, encircled near the apex by an acute horizontal rim.—South Carolina, Georgia, throughout the gulf states in the region of the gulf, extending westward to Southern California and Chihuahua, and southward into Mexico as far as San Luis Potosi. Very near *A. paronychioides* in external aspect. Type unknown.

***Staminodia short, dentate.*

2. A. PUNGENS HBK. Nov. Gen. et Sp. 2: 206. 1817.

A. Achyrantha leiantha Seub.

A. echinata Sm. Rees Cycl. Suppl. no. 10.

Very similar to *A. repens*, but with larger leaves, echinate heads, the bracts and two of the perianth segments armed

with long aristæ and short wide dentate staminodia, which resemble those of *A. paronychioides*, but with fewer teeth.—Native of southern Mexico and South America, but introduced at Mobile, Alabama. It is not known to be abundant anywhere.

Although this species is referred to by Moquin-Tandon among "*Species non satis notæ*," one of the specimens studied (Paraguay *Morong* 39) was identified by Dr. Britton at Kew, thus further confirming the decision already reached *ex char.* The smaller-leaved forms approach *A. repens* very closely, but the staminodia character serves to give it specific rank. Type unknown.

3. A. PARONYCHIOIDES St. Hil. Voy. Brés. **2**: 43. 1823.

Habit of *A. repens*, but less diffuse, with glabrate stem freely rooting at the nodes, narrower leaves with longer petioles, strongly compressed flowers, thin acute sub-equal pearly-white hairy sepals, much exceeding the utricle, short wide 3-dentate staminodia, and strongly compressed obcordate broadly margined utricle.—North Carolina, southward throughout the gulf states near the gulf. Native of the lowland tropics.

This species has been generally confused with *A. repens*, to which the specimens in our herbaria have mostly been referred. It may be recognized at once by its thin, white, exaristate sepals, although its more deep-seated distinction lies in the staminodia. This, and the next preceding, show more strikingly than any other forms the intimate relation of *Alternanthera* to *Telanthera*, occupying a position directly intermediate between *A. repens* on the one hand, and *T. ficoidea* on the other, both in habit and in the character of the staminodia. Related also to *A. pilosa* of South America. Type unknown.

*** *Staminodia long (equaling or surpassing the filaments), toothed or fringed.*

+ *Calyx sessile.*

4. **A. Kerberi,** n. sp.

Diffuse, ascending, pubescent, with numerous joints, the lower ones putting out numerous long fibrous roots: leaves small (3^{cm} long or less), narrowly spatulate, crowded: heads very small, sessile in the axils: bracts short, wide, deeply laciniate-margined: flowers small (2^{mm}): sepals unequal, darkly

colored on the back, scarious-margined: staminodia narrow, fringed at apex, equaling the filaments: mature utricle not seen.—State of Vera Cruz, Mexico. Our plant appears in every way to have grown in muddy or wet places. Cultivated forms from Washington and Philadelphia showing flower and bract characters identical with the type may have sprung originally from this form; but they differ strongly in plant habit, being glabrate, with larger and fewer leaves, and bearing no evidence of rooting nodes, although the lower part of these plants has not been seen. If there is such an indigenous form anywhere in existence, it undoubtedly belongs with *A. Kerberi* as a variety. The species may be recognized at once by its bracts.

Type (Atoyac, Vera Cruz, *Kerber*, May, 1883) in herb. J. D. Smith. Cultivated specimens here referred to are in herb. Columbia College and Nat. herb.

5. A. MARITIMA St. Hil. Voy. Brés. **2**: 43. 1823.

Illecebrum maritimum Sprengel Syst. Cur. Post **4**: 103. 1829.
Telanthera maritima Moq. l. c. 364. 1849.

Smooth and fleshy (black on drying): stem prostrate, angled, branching: leaves obovate, mucronate: flowers in small numerous axillary heads, triangular, closely sessile, leaving a wide depressed scar when removed: sepals rigid, indurate, ovate, acute, slightly aristate, about 5-ribbed, one-third longer than the wide keeled bracts: staminodia slightly longer than the filaments.—Southern Florida, where it has come in from the tropics by way of the West Indies. Type unknown.

6. A. STELLATA (Wats).

Telanthera stellata Wats. Proc. Am. Acad. **21**: 436. 1886.

Herbaceous, ascending, branched, clothed throughout with short stellate pubescence: leaves ovate to lanceolate, acute, 2 to 5^{cm} long: heads sessile in the axils: flowers dorsally compressed: sepals unequal, the outer ones 3-nerved, rigid, pubescent with simple hairs, slightly aristate, somewhat recurved in maturity: staminodia exceeding the filaments.—Chihuahua and Sonora, Mexico.

Type (San Miguel, Chihuahua, *Palmer* 4, in 1885) in herb. Gray, Columbia College, Nat. herb. and herb. J. D. Smith.

'A. STELLATA GLABRATA (Rose).

Telanthera stellata glabrata Rose in Nat. herb.

Plant glabrous throughout; otherwise not differing from the species.—Sonora, Mexico.

Type (Alamos, Sonora, *Palmer* 660*a* in 1890) in Nat. herb.

7. A. PHILOXEROIDES (Mart.) Griseb. in Goett. Abh. **24**: 36. 1879.

Bucholzia philoxeroides Mart. Beitr. Amarant. 107. 1825.

This species has been found at Pensacola, Florida (*Mohr* 26), and at Coosan, South Carolina (*Cohen* in 1885), where in both cases it is probably adventive.

÷ ÷ *Calyx pedicellate.*

8. A. BRASILIANA (L.) Kuntze Rev. Gen. Pl. 537. 1891.

Gomphrena Brasiliana L. Amœn. Acad. 4: 310. 1759.
Gomphrena patula Wendl. Beob. 43. 1798.
Mogiphanes straminea Mart. Nov. Gen. et Sp. Bras. 2: 35. *pl. 135.* 1826.
Mogiphanes ramosissima Mart. l. c. 31. *pl. 130.* 1826.
Philoxera Brasiliana Smith in Rees Cycl. 5: 27. —.
Celosia altissima Salzm. ex. Moq. l. c. 381. 1849.
Telanthera Floridana Chapm. Fl. S. U. S. 383. 1883.

Herbaceous or suffrutescent, mostly erect, slender, elongated, remotely jointed, forking or branched, often swollen at the nodes, from glabrate to villous: leaves small (1 to 7^{cm} long), ovate to lanceolate, acuminate, short petioled: heads ovate or sometimes cylindrical in maturity, long peduncled: bracts short, persistent: flowers 4^{mm} long, 3 times the length of the bracts, deciduous, raised on a short dilate 5-angled pedicel: sepals pubescent, yellowish: utricle crowned with a narrow rim as in *A. repens.*—Florida, where it has crept in from the lowland tropics.

Type unknown. Chapman's types of *T. Floridana* are in herb. Columbia College, and herb. J. D. Smith.

A careful test has been made with reference to the validity of the pedicels as diagnostic characters. It is found that the dilate, 5-lobed pedicels of this species are quite distinct and constant, having been seen nowhere else in the large number of both native and tropical specimens studied except in *Alternanthera rosea* (Morong) U. & B., which, unlike *T. ramosissima* Moq., has other peculiarities sufficient to keep it apart. Dr. Kuntze, disregarding this fact, has united certain species under *A. bicolor* OK l. c., which on this basis are seen to be clearly and constantly distinct. Moreover, his observations on the color of the flowers, even if correct, do not seem to offer sufficient ground for uniting so many species on that character alone. It is artificial in that he has relegated floral

structure to a place of secondary importance. While there is no question that Moquin-Tandon has multiplied species far too freely, we are unwilling to accept this color basis as a satisfactory solution. Again, why has he not followed the law of priority and adopted the earliest published name from among the merged species, instead of naming *de novo?*

A. BRASILIANA MOQUINI (Webb.).

Telanthera Moquini Webb. ex Moq. l. c. 379. 1849.

Plant glabrate, suffruticose, with ovate leaves larger and wider than in the species, and slender 5-angled pedicel.—Florida Keys.

Type (Key West, Florida, *Blodgett,*) in herb. Columbia College. Only one Florida specimen was seen, but it conforms closely with authenticated South American specimens.

A. GRACILIS (Mart. et Galeot.) occurs as far north as Tampico, Mexico, but has not yet been reported from our territory.

A. FICOIDEA RADICANS R. & S. (incl. *T. polygonoides* Moq.) was said by Moquin-Tandon to have been found in Carolina. Chapman has adopted this, on the strength of which he includes *T. polygonoides* in his Southern Flora. The very close resemblance of this variety (*ex descr.*) to the indigenous *A. repens* and *A. paronychioides* of that region, together with the fact that *T. polygonoides* has not otherwise been known north of the West Indies, make it quite probable that Moquin's plant was one of the above species.

Telanthera polygonoides brachiata (Schrad.) Moq. l. c. = ALTERNANTHERA FICOIDEA BRACHIATA (Schrad.).

Mogiphanes rosea Morong in Ann. N. Y. Acad. Sci. **7**: —. 1893 = ALTERNANTHERA ROSEA (Morong).

Telanthera Tuerckheimii Vatke ined. = GOMPHRENA TUERCKHEIMII (Vatke) U. & B. in Bot. Gaz. **20**: 161. 1895.

Lake Forest University.

Noteworthy anatomical and physiological researches.

The littoral flora of Belgium.[1]

The flora of the Belgian littoral presents so many points of interest in common with those which may be found along our own seaboards and the great lakes, that it has seemed fitting to give a somewhat extended abstract of this paper. As the original title suggests, it is not a mere list of plants growing upon the coast of Belgium. On the other hand the subject is treated entirely from a biological standpoint and is well deserving of the attention of American botanists, many of whom have unsurpassed advantages for undertaking similar lines of study.

The most important topics, are indicated by corresponding subheads in this résumé.

1. *Physical conditions.* The shore of Belgium consists of a continuous range of dunes of moving sand, varying in width from 3^{km} to a line so narrow that it is reinforced with dikes. Between these dunes are more or less deep and extended valleys.

The calcium carbonate and other salts which are dashed over these hillocks by the waves filter quickly through the light sand. The wind is continually changing the contour of the dunes, which are remarkable for their dryness. The valleys separating them, on the contrary, are kept more or less moist owing to an impermeable stratum of clay which underlies them. The largest valleys are called "pannes" and are frequently cultivated. Their flora resembles that of the marshes of the interior, and is devoid of any peculiarly littoral character.

Where the Yser empties into the sea the tide backs up carrying with it the particles of earth held in suspension by the river water. These are deposited along the estuary forming sheets of clay called "schorres."

Owing to the action of the waves a constant subsidence of the hills takes place, although this is sometimes counter-balanced by new dunes formed by the sand deposited by the ocean currents.

[1] La biologie de la vegetation sur le littoral Belge. Jean Massart. Bull, de la Soc. roy. de Botanique de Belgique. **32**: 7-43. *4*. 1893.

The dunes and the schorres possess each a distinct type of vegetation. The plants of the former, owing to the extreme dryness which prevails, obtain water with great difficulty and furnish a series of structures adapted to secure proper absorption and storage of the water taken from the soil, and a reduction of the loss of water by evaporation. The wind, too, offers a very serious obstacle to the dune plants in their development. It lays bare their roots, enfilades the plants with sand, or buries them deeply in the drifts.

Owing to unlike conditions of existence the schorre vegetation is quite different. The earth is so compact that rain does not penetrate it; moreover, twice each day it is entirely inundated by the sea. Instead of resembling the flora of the marshes, the schorre plants, like those of the dunes, are adapted to drouth. This is due to their xerophilous character. As is well known, vegetation becomes xerophilous not only in localities where water is rare, but also in places where, although sufficiently abundant, it occurs in such a state as to be absorbed with difficulty. Thus the frequent and apparently astonishing xerophilous character of arctic and alpine plants which push into the water, is due to a large extent to the reduction of the amount of water which they can take from the soil, resulting from the simple cooling of the earth.

In the case of vegetation in contact with the sea or an equally strong solution of salt, the plant absorbs water with difficulty since the liquid of the cells is much less concentrated than that of the external solution. Hence such plants need to economize their water so as not to be compelled to renew it frequently.

2. *Means of protection against drouth.* The winters on the Belgian coast are humid and comparatively mild, while extreme drouth prevails during the summer. Hence many of the dune plants are exclusively bibernal in their growth, and, dried and shriveled, pass the summer in a dormant state.

The schorres, on the contrary, are almost completely deprived of vegetation during the winter; the only plants which remain green are those with very short leaves (Glyceria, Armeria, etc.). This fact is probably due to the periodical submergence which the schorres undergo; the partly frozen water brought in by the tide tears up the soil and pulls out everything above its surface.

The faculty which dune plants possess of developing in winter and early spring has doubtless been acquired in order that they may escape the unfavorable conditions to which they would be subject in summer.

Various contrivances are possessed by the dune plants for securing the absorption of water and preventing its evaporation. Chief among the former is the very extensive root system with which nearly all of them are provided. Eryngium maritimum, for example, often has roots more than 3^m long.

A good number have their leaves so arranged as to protect the soil against evaporation; they are applied closely to the sand, as in Erodium and most of the Compositæ (Thrincia, Leontodon, Senecio Jacobaea, etc.). Upon pulling the plant up by the roots it is seen that the leaves bend back towards the base; the petiole forms a spring, probably due to a difference in turgescence between the upper and lower face, and presses the blade energetically against the soil. This prevents the wind from disturbing the superficial layers of sand, and thus checks evaporation.

Other species, very numerous, form a screen; the wind breaks against them before striking the earth. Some of these are shrubs, as Hippophaë, Ligustrum, Salix repens, etc.; others are low, cushion-like herbs, such as Galium Mollugo and G. verum, Ononis repens, Anthyllis Vulneraria, etc.

Contrivances for storing up water are common, advantage being taken of the intermittent rains to make provision for water against periods of drouth.

Fleshy plants, however, are rare in the dunes; only Sedum acre, Euphorbia Paralias, Lotus corniculatus var. crassifolius, Convolvulus, Soldanella, etc. are found. This dearth of fleshy plants is attributed to the destructive action exercised upon them by the wind charged with grains of sand; it is rare to find an adult leaf of a fleshy plant, of Lotus, for example, which is not injured in many places.

Wherever the land is subject to tides, as on the schorres and at the base of the dunes close to the sea, plants with fleshy leaves or stems predominate. Among such plants are Cakile, Salsola, Honckenya, Salicornia, Suaeda, Statice, Armeria, Glaux, Spergularia, etc.

The author attributes the stunted condition of the littoral plants to the fact that they seek in every way to limit the loss of water; transpiration is thus reduced and the amount of

food correspondingly lessened. From the law that transpiration is more rapid on a convex than on a plane surface the author explains the fact that the epidermal cells of Glyceria, Agropyrum, and Lotus corniculatus growing in saline soils are almost flat while the same plants in aquatic situations have strongly convex epidermal cells.

The dune plants have an abundant clothing of hairs, which being feeble conductors of heat, considerably reduce transpiration. Many of the xerophilous plants have a very pronounced odor, e. g., the stems of Thymus Serpyllum belong almost exclusively to the variety citriodorus, which is much richer in volatile substances than the type. The evaporation of this volatile matter creates around the plant an atmosphere through which heat rays pass with difficulty.

Transpiration is also lessened in many of the grasses by the well-known phenomenon of the conduplication and inrolling of the leaves. In such grasses the stomata are almost always upon the upper side of the leaf. In others evaporation is hindered by the possession of thick cuticles, strongly impregnated with suberin, and in the case of Agropyrum and other grasses by the thickening of the walls of the cells composing the fibro-vascular sheath. The increased transpiration which results from shocks is hindered in the dune plants by their remarkable rigidity, which is due both to the rolling up of the leaves and the extraordinary development of sclerenchymatous tissue. The plants of the schorres owe their rigidity to their fleshy nature.

Injury from excessive light is prevented in some cases by the hairs situated upon the upper surface of the leaves, shading the green cells, thus hindering chlorovaporisation. In the genus Halimus the edges of the leaves turn towards the sun to secure the same object.

3. *Protection against the wind and animals.* The high winds exercise a very destructive influence upon the littoral flora, not only by breaking stems, tearing leaves and denuding the roots, but also by their great drying action. To obviate this the majority of the arenicolous plants are tough and elastic; others have strong hold-fast roots or a compact and prostrate habit; still others produce numerous stolons.

Protection against animals of the littoral, of which the rabbit is chief, is afforded to some plants by their hard character and impregnation with silica; some (Hippophaë, Eryngium)

are armed with spines; others (Ononis) are covered with sand; still others have a bitter taste (Salix, Galium verum), or are acrid (Euphorbia Paralias); many contain essential oils displeasing to herbivora, finally, the fleshy plants, the most exposed of all, are strongly protected by their saline flavor (Cakile, Salsola, Salicornia, Aster, Statice).

4. *Origin of the littoral flora.* The paucity of species of the littoral flora is accounted for by the diversity of destructive causes at work, which also explains the great number of individuals in the case of those plants which are well adapted to the prevalent conditions.

In order to throw light upon this subject the author has sown and transplanted to Brussels a large number of the plants of the dunes and schorres. This will be followed by a study of whatever modifications take place because of this change of environment. The inverse experiment has also been tried of transplanting 400 species of perennials cultivated in the Botanic Garden at Brussels, to various places along the coast. —GILBERT H. HICKS.

Nature and life history of starch grains.[1]

The recently published work of Meyer forms the most important contribution to the knowledge of starch grains which has appeared since Schimper's researches in 1880. According to Meyer, starch grains are true sphere crystals in every way analogous to the sphere crystals of inulin, and are composed of two forms of amylose and a trace of amylodextrin. In an anomalous form which colors reddish-brown with iodine, the proportion of amylodextrin is very large. This red starch is characteristic of a large number of saprophytes but has been found in less than a score of the higher green plants. In opposition to the theory of Tammann, Meyer finds that the action of diastase on starch is a purely katalytic process and in every way analagous to the katalytic action of acids except that it is more easily influenced by external conditions, such as heat, etc.

Under diastatic action, amylose takes up water and splits into two molecules of amylodextrin, which is transformed into isomaltose and dextrin. Both of these substances pass

[1] Arthur Meyer. Untersuchungen über die Stärkekörner. Wesen und Lebensgeschichte der Stärkekörner der höheren Pflanzen. pp. xvi+318. pl. 9. figs. 99. Gustav Fischer. Jena. 1895.

into maltose. The validity of the observations upon which is based Nägeli's hypothesis as to the growth and structure of starch grains is denied in toto. The grains have their origin and growth entirely within chromatophores where they are held as long as the cell is living. Growth consists of the superposition of new layers of material on those previously formed. The layers or coats are due to the periodic activity of the chromatophore. The contour of the grains is due entirely to the pressure exerted on the chromatophore by the cytoplasm, and the size depends upon the biologic relations of the plant. Thus in rapidly germinating seeds or in other structures where rapid solution of reserve material is desirable, the grains are small, and easily fissured. The granula of the chloroplasts are regarded as the organs of synthesis of the carbohydrates, and the stroma as the organ of formation of starch material and diastase. In the consideration of the morphology of the chromatophore the author is led to conclusions in harmony with Berthold's theory of the emulsion structure of protoplasm. In a series of monographs which form an appendix to the chief thesis, he describes the results of his researches on the seasonal periodicity and other biologic relations of the starch grains of Dieffenbachia seguina, Pellionia daveauana, Hyacinthus orientalis, Cyrtodeira cupreata, Adoxa moschatellina, and Hordeum distichum. The book contains all of the author's work upon starch, much of which has been previously published. It is well illustrated and logically arranged. The great number of macro- and micro-chemical reactions given makes the work invaluable in the laboratory. With this work at hand the archaic views as to the composition, structure, and growth of starch grains which find place in the best botanical as well as chemical text books will no longer be excusable.—D. T. MAC DOUGAL.

Arctic and Alpine plants.[1]

The present paper by Bonnier points out the difference in structural development of some arctic plants as compared with the same species collected in the Alps and Pyrenees. The arctic plants were collected by Charles Rabot, who visited Jan Mayen and Spitzbergen in the summer of 1892. We must note, however, that since these plants were col-

[1]Gaston Bonnier: Les plantes arctiques comparées aux mêmes espèces des Alpes et des Pyrénées. Revue gén. de Botanique **6**: 505–527. *pl. 4.* 1894.

lected on the shore of these islands where heavy fogs prevail during the summer we do not get a complete illustration of the anatomy of the arctic plants. The climatic conditions vary greatly in the polar regions, and there are certainly many places, where the summer has sunny days with clear sky, at least during the months of June and July. The paper is nevertheless very interesting and we record some of the most important results. Oxyria digyna, Saxifraga oppositifolia, Salix reticulata, Silene acaulis, Cerastium alpinum, Potentilla nivea and Poa pratensis are described anatomically, and a few other species are briefly discussed. The anatomical examination comprises the leaf, the stem, the inflorescences and the root, and the accompanying plates contain several good figures showing the habit of some of these species and their anatomical structure. As compared with their alpine representatives the following modifications are observable as characteristic of arctic species:

1. The lignified elements are reduced in number; their cell-walls are less thick and the lumen of the vessels much narrower than in the alpine plants.

2. The leaves are thicker but less differentiated; the palisade tissue is less pronounced; the intercellular spaces are more developed.

3. The epidermis of the stem and leaves is less coherent and the cuticle less thick.

4. The cells of the various tissues of the stem, the leaves and the root show a tendency to a roundish outline; some of the cells often develop like trabeculæ, and these separate large intercellular spaces.

The author believes that the causes of these anatomical modifications are especially the atmospheric humidity and the character of the light. The most important factor is, of course, the light of the midnight-sun which is continuous in the summer months, but not so intense as the light in the Alps. The humidity of the soil and the temperature do not seem to cause any modifications of importance, at least not in the plants examined.—THEO. HOLM.

BRIEFER ARTICLES.

On the derivation of Linnæan specific names.—At page 360 (July issue) of *Popular Science Monthly*, is a paper by Dr. John P. Lotsy on "Herbaria in their relation to botany." While the paper has much of value, it rather underrates the services of those who can name at sight any plant presented to them, which, the author says, was "what was understood as a botanist in Linnæus' time." Morphology, histology, and physiology he regards as of greater importance. There seems no necessity for depreciating the study of systematic botany in order to elevate the other branches. The best proof of this is the fact that most of the ablest workers in these fields, are distinguished as systematists.

But the point I have in view in this note is to call attention to a very excusable error, into which Dr. Lotsy has fallen, that Linnæus is the *originator* of the so-called Linnæan names. He "resolved" says Dr. L., "to give every plant two names, the first one being the genus name, here Ranunculus, the second one expressing some particular kind of Ranunculus, and thus indicating the species. Thus he found, for example, that one buttercup had an acrid taste, and he called it the acrid buttercup in Latin, *Ranunculus acris;* that another one only grew in marshy places, he called it the marsh buttercup, in Latin *Ranunculus palustris*, etc."

A study of the work of Linnæus shows that when he took in hand to reduce the labors of his predecessors to a binomial system, he usually adopted some one of the specific terms already employed by them—frequently the last term, whatever that might be, or even though it might be on general principles inappropriate. Whenever there was no opportunity to make use of terms already in use for his specific names, his choice seemed to be geographical ones. The genus Ranunculus, already introduced by Dr. L. furnishes a good illustration of this. He did not "find that one buttercup had an acrid taste, and he called it" Ranunculus acris, for Bauhin had "found" this long before. He had styled it *Ranunculus pratensis erectus acris*. All Linnæus did was to strike out all but the first and last words of the sentence. In some cases he adopted the generic names of his predecessors for his specific names. Dodonæus, for instance, had a genus Flammula, represented by our *Ranunculus Flammula* as Linnæus reduced it. *Ranunculus reptans*, was the *R. foliis linearibus caule repente* of his early "Flora Lapponica." *R. gramineus* was Bau-

hin's *R. montanus graminœofolio.* *R. parnassifolius* was Tournefort's *R. montanus graminis parnassifolio.* *R. bullatus* is Bauhin's *R. latifolius bullatus.* Unfortunately for Dr. L.'s illustration he never established a *R. palustris.* There was, to be sure, Bauhin's "*R. palustris apiifolio lævis,*" but for once he ignored both the swamp and the smooth parsley leaf, and dubbed it *R. Sceleratus.* Thus we might go through the whole list of the Linnæan ranunculuses. *Ophioglossoides* is from Villars, *Ficaria* from Haller, *Thora* from Crantz, *Creticus* from Bauhin, *cassubicus* from Breyne, *aconitifolius* from Bauhin, *rutæfolius* from Bauhin, and so on of many others, a large number being Bauhin's names.

In the reorganization of systematic botany, Linnæus was a collator and condenser, rather than a creator, and the fact that, as far as possible, he preserved the work of his predecessors, and did all honor to their labors, justifies the high estimation of his personal character so generally entertained.—THOMAS MEEHAN, *Germantown, Philadelphia.*

A day-blooming Cereus grandiflorus.—Our Cereus grandiflorus has, on three occasions and with five different blossoms, made a fatal and in no instance entirely successful effort to expand during the day. In each case the abortive attempt was caused by a sudden marked lowering of temperature *when the bud was almost ready to open,* thus retarding the growth.

In the first instance, a year ago, the flower partly opened about 8:00 A. M. on the second day after it had to all appearances planned to expand had external conditions proved favorable. It soon drooped, however, as the sun's rays fell upon it.

This year the cold wave early in July, with mercury at 44° at 7 A. M., and but little higher at mid-day, caught two fine buds in a similar manner. Again expansion was retarded at least one, and, I am inclined to think, two days and several odd hours. They opened sufficiently to show the interior at 10:00 A. M. and 11:00 A. M. respectively, and like their abnormal predecessor soon drooped in the sunshine (the plant stands on a south porch), and did not revive with the approach of twilight as a friend fondly hoped.

Again, Aug. 1st, two other buds similarly retarded behaved in the same way. The day was cool and cloudy. At 9:00 A. M. the sepals of one had loosened at the tip. From 9:30 to nearly 10:00 o'clock the phenomena that attend the normal opening of this beautiful flower were present. At 10:00 A. M. the maximum was seemingly reached. The petals were then open nearly as wide as is their custom, the outer sepals, instead of bending back almost to the tube, opened at nearly a right angle with it; the stigma, as in all previous abortive ef-

forts, only partly opened. On the whole, the flower was a very creditable specimen, and the novelty of seeing so fine a one in broad daylight was duly appreciated. In half an hour more the sun, which shone dimly at times, was beginning to tell upon it. I cut it off, placed it in water in a dark room, where it remained with little change until 1:30 P. M., when it rapidly withered. Its companion was a little less ambitious in every respect, and was in its prime at 11:30 A. M., but being allowed to remain on the plant, proved more transient.

Other buds which reached maturity when the weather was warm opened in the usual manner.—BESSIE L. PUTNAM, *Harmonsburg, Penn.*

Ustilago Reiliana on corn.—*Ustilago Reiliana* Kühn was discovered several years ago at this place on sorghum and was first reported from here for America. Since then it has occurred in abundance in sorghum fields in other parts of the United States. Last year and this year it has been common in the experimental sorghum fields of this college; but up to this time has not been reported, to my knowledge, on *Zea Mays* from this continent, though found on that plant in Europe. The first stalk of corn affected by this smut was found in July of this year, and since then I have seen it quite frequent in fields about Manhattan. The smut usually appears first in the male inflorescence of the host plant, sometimes converting the whole upper part of the plant into a mass of smut, sometimes smutting only some of the flowers which are usually in this case enlarged and deformed. The whole plant is much dwarfed by the parasite, scarcely attaining more than half the normal size. The ears are small, and when not filled with the smut they are deformed, often very curiously, and scarcely ever develop any perfect grains. The rudimentary ears at each node from the base of the plant upward are nearly always affected. *Ustilago Reiliana* might be mistaken by the ordinary observer for *U. maydis* the usual corn smut, and is perhaps more common than generally supposed; but they are easily distinguished when seen together. *U. Reiliana* has a more granular appearance, as if mixed with meal, due to the large colorless cells which accompany the spores. The fibers which remain in the smut mass are much larger than in *U. maydis*. The microscopic characters will of course distinguish the two species. A difference of greater economic importance lies in the fact that *U. Reiliana* attacks the whole plant, almost destroying it, while *U. maydis* is more local, and plants affected with it usually appear uninjured except at the point attacked by the parasite.—J. B. S. NORTON, *Kansas State Agricultural College, Manhattan.*

Note on buffalo grass.—I read with interest an article by Mr. Plank on "Buchloe dactyloides Englm., not a dicœcious grass."[1] He asserts that the grass in question is not dicœcious, as usually described, but moncœcious, and in support records observations made in Kansas.

Wishing to satisfy myself experimentally as to the correctness of this assertion, a few seeds were germinated in the greenhouse in the spring of 1893. A single seedling was transferred to an outdoor plat. This grew vigorously through the season, sending out stolons and forming a compact mat. During 1894 the mat became larger and denser, but no flowers appeared.

However, the plant flowered this season (1895). Both staminate and pistillate flowers were present, the former preponderating. The flowers arose mostly from nodes that had taken root and thus become essentially independent plants. In no case did I find the two kinds of flowers from the same node, but from the interwoven state of the stolons I was unable to determine whether the two kinds of flowers were borne upon independent stolons.

The plant was first described by Nuttall (Gen. 1: 65. 1818) from a staminate specimen, and named *Sesleria dactyloides*. He is evidently doubtful about the plant belonging to the genus Sesleria.

Rafinesque having occasion to review Nuttall's Genera (*Am. Monthly Mag.* **2**: 190. 1819) makes a note regarding this plant: "18. *Sesleria dactyloides* must form a peculiar genus by Mr. N.'s own account. It may be called *Bulbilis*." It is upon this basis that Dr. Otto Kuntze establishes *Bulbilis dactyloides* (Nutt.) Raf. (Rev. Gen. Pl. 763).

Nuttall remarks in his description: "Root, after flowering, resembling a bulb," from which, doubtless, Rafinesque derives *Bulbilis*. Upon the margin of the copy of the *American Monthly Magazine* above quoted (in the library of the Missouri Botanical Garden), some one has suggested another derivation, "bull's bile!"—A. S. Hitchcock, *Kansas Agricultural College, Manhattan.*

[1] Bull. Torr. Bot. Club. **19**: 303. 1892.

EDITORIAL.

THE SPRINGFIELD meeting of the American Association for the Advancement of Science showed a marked decrease in the number of papers presented before it, and especially in the attendance. The proportional number of botanists was, however, somewhat larger than usual, although the actual number did not reach the point anticipated. During the last few years the botanical element at the annual meetings has been conspicuous both by reason of its numbers and its enthusiasm. It has also usually been one of the leading sections in the number and interesting character of its papers. In these particulars the recent meeting showed a decided falling off. Only twenty-seven botanical papers were placed on the program and quite a number of these were not read, mostly because the authors did not remain in Springfield until the papers were called. Altogether the meeting did not come up to the standard of its predecessors.

IT IS PERTINENT to enquire into the cause of so great a change. Is it due to a general decrease in botanical interest, to the lack of novelty which for awhile might have attracted members, to any interruption of good fellowship which may keep away a faction, to the establishment of other societies drawing off the papers and attendance, to any want of suitable provision for social entertainment, to internal friction or inconvenient arrangement of the program, to the development of the science so that it no longer needs the stimulus of such a gathering, or to some still unmentioned cause? The matter was considerably discussed at Springfield, and much diversity of opinion manifested. It was generally conceded that there was a variety of causes, and that the conditions in the botanical section were not materially different from those affecting the other sections of the Association. Without entering upon these arguments, although some profitable things might doubtless be said, we may state that in our opinion the main difficulties have been met in the proposed arrangements for the meeting next year at Buffalo. Two prominent innovations are to be tried: the meeting will begin on Monday and close on the following Saturday, giving Tuesday, Wednesday, Thursday and Friday to the uninterrupted consideration of papers and other legitimate work of the society, and a provisional program will be issued by the officers of the section at least a month before the time of the meeting. Both of these changes are important.

THE TWO DAYS' break of Saturday and Sunday, which has heretofore occurred, has always been detrimental. The present year the reading of papers began on Friday morning, and the program for this day was fully carried out as printed on the daily announcement, with a good audience present. When Monday morning arrived it was found that many of the members had not returned to Springfield after the excursions of Saturday, and the daily program was but partially carried out, with a very small audience present, and the continuance of the sessions for Tuesday and Wednesday was abandoned. It seems highly probable that such a collapse of the program will be out of the question with the change to uninterrupted sessions proposed for next year.

ISSUING a printed program in advance of the meeting is the most important measure for increasing the interest and making the matters presented thoroughly available to the members in attendance that has yet been tried. If well carried out, it will be possible to know beforehand what subjects are to come up that may interest one, and at what time they can be heard. This arrangement can not fail to add great attractiveness to the meeting, and it is much to be desired that members lend their hearty cooperation to the efforts of the officers in securing a good program.

SOME WORDS might be said about the general usefulness of the Association. So far as the botanists are concerned, they owe much of their present prestige, both at home and abroad, and of their affiliations as a representative national body, to the opportunities created by the Association. The possibilities for gaining additional advantages through the same medium are by no means exhausted. The value of the Association to the individuals who attend its meetings does not admit of a doubt, in the majority of instances, and increases greatly with the increase in attendance.

CURRENT LITERATURE.

A guide to wild flowers.

That there is a deep popular interest in the flowers of the field must have impressed itself upon any person who was so fortunate as to be a part of the very large audience that saw the projections of the colored lantern slides of Mr. and Mrs. Van Brunt in Springfield during the recent meeting of the American Association for the Advancement of Science. The spontaneous and enthusiastic applause, especially when a favorite flower came upon the screen, made it manifest that it was not the beauty of the representations alone that attracted the audience, but an intelligent interest in the different species of plants. The success of Mrs. Dana's guide[1] to the wild flowers, which has now reached its twenty-seventh thousand, is another evidence of the same fact.

The work has been enlarged and improved in the present edition, but not changed in character from the earlier edition, which was noticed in these pages.[2] The volume will be of assistance to many persons who would not take the trouble to look up the names of plants in a technical work, and it will be read by some who are simply interested in the author's well written account of the different flowers. The illustrations are an attractive feature of the volume. They have a certain artistic merit, but possess little of the characteristic pose and texture of the individual plants, and are not likely to be of great aid to the novice in locating a plant in hand.

In short it seems to us that the volume is a very poor one with which to study the flora of a region, but a very good one to have at hand for occasional assistance and information. For the niche in which it belongs the book is an admirable one, and most welcome, but it is not to be expected that it will serve the purpose of a strict manual. The author intimates that it was written to meet the demand of those who wish to name flowers "without the trouble of analyzing them." Bearing this limitation in mind, we have little else but praise for the work. The volume is well written and attractively printed and bound.

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[1] DANA, MRS. WILLIAM STARR: How to know the wild flowers; a guide to the names, haunts, aud habits of our common wild flowers. Illustrated by Marion Satterlee. Revised and enlarged edition. 12mo. pp. xvii + 373. pl. 156. New York: Chas. Scribner's Sons. 1895. $1.75.

[2] **18:** 319. 1893.

OPEN LETTERS.

The nomenclature question: Some points to be emphasized in the discussion.

In very recent literature may be found a discussion by the geologists that descended to unpardonable personality and vindictiveness, to which the attention of botanists may yet have to be recalled. In fact, an article has already been distributed that belongs to this category, for refusing to publish which the editors of at least two journals will be commended by all who favor dignified and honorable discussion of the points in dispute.

It would be wholly superfluous to argue at length for the entire elimination of personalities and imputation of improper motives in the discussion of any topic, and a mere allusion to the subject is sufficient. Equal condemnation should be meted out to those who attempt to belittle the work of their opponents, and to decry the branch of science cultivated by them. Such expressions as the "virtual exhaustion of the field of North American botany," "botanical nomenclature is not a scientific matter anyway," may be cited as the milder examples.

That there should have been some misunderstandings we must expect where the subject is of such deep interest as this reform in nomenclature has proven to be. While we do not criticise the disputants, we must deplore the fact that there occurred even unintentional depreciation of the character or standing of any representative body of botanists, or an unwarranted interpretation that charged such depreciation. But the answer has been given and should be accepted as satisfactory and final. A remark that was likewise unfortunate, "lay aside personal prejudice and join the remaining nine-tenths," has given much offense, apparently, to the opponents of reform. But I doubt not that the sentence was penned in a jocose mood, and surely did not deserve the attention it received.

It must be insisted that, while it may or may not be "out of place" for certain ones now to raise objection to the entire system of reform, when, in fact, the reform is virtually accomplished, those who have been instrumental in bringing about this change have not, in the least degree, intimated that discussion is to come to an end. Touching the points settled or the points unsettled, discussion can go on, freely as before. In fact, minor points are not fully agreed upon, and demand farther consideration. The cardinal principles are, however, settled as really as the foundations of organic evolution were determined when Darwin published his Origin of Species, though a storm of acrimonious opposition immediately broke forth.

It avails nothing to say that the "majority," or "nine-tenths" or the "non-systematic botanists," or the readers of horticultural journals, etc., are opposed to the system. In science, as elsewhere, the right will prevail ultimately. That this reform will even be inconvenient to the great mass of non-systematic botanists and readers, can scarcely

be claimed. It will, at most, be so to the few scores of botanists who have learned a few hundred names and have frequent occasion to use them, and to the teachers who "analyzed" flowers some years ago, and to whom would be annoying any changes in botany while they continue to have classes. This inconvenience will, however, disappear (except to those "teachers") in a brief time, and the trouble will be forgotten as soon as the Manuals give the correct names. Lists, catalogues, monographs, magazine articles, etc., that are now appearing, are fast supplying the names according to the new system, and the cry of "instability" while these changes are being accomplished, will likewise disappear shortly.

But even if this "inconvenience" were really great, and the mass of the people opposed to the reform, these facts would be no argument against the application of the main principles, which for some time have received recognition in the several departments of natural history. It may be added that foreign botanists—to wait for whom such earnest appeals have gone forth—quite generally accept the initial date for genera and species adopted by the Americans. That they really recognize the chief corner stone of the system, namely, the doctrine of priority, is shown by the fact that they wish others to join with them in excepting a greater or less number of genera from the effect of its application. Other and minor points receive recognition in part, so that on the whole the anxiety lest Americans may go too fast seems to be groundless.

Both publicly and privately it has been hinted and claimed that the List published has not yet been adopted nor officially sanctioned by the Botanical Club, as if that had something to do with the principles that were adopted, and according to which the committee was instructed to prepare the list. But, for a moment, suppose it were a matter of importance, how far is the claim really well founded? The committee was instructed not to consider and report on a subject, or to formulate a judgment or make recommendations, but merely to do a certain piece of work. The case is comparable to that of a committee to notify a person that has been nominated for a certain office or position, or to engross and present a memorial, or some similar work. It is evident that a discharge of the duty is final and could not in the nature of the case call for "authoritative sanction." If one raises the question as to whether the work of the committee on nomenclature was done according to the instructions given, then the question of "sanction" can be thought of. But the point here to be emphasized again is that this has absolutely nothing to do with the main question in the reform movement.

One other matter deserves a further remark. The opponents of change and reform say that nothing should be done at present because very soon there will be an international congress of botanists. Several have said in substance, both privately and publicly, that they would agree to the dictates of such a body and fall in line with whatever might be done. In other words, they resent the idea of authority when exercised (supposedly) by the Botanical Club, but covet the same when exercised by a larger body. I think their statements are made without due consideration. For my part, I consider nothing

"binding," and will not agree to subscribe to and act in accord with anything that my judgment condemns. I rather think the systematic botanists will do the same. The "non-systematic botanists" may join together and repeal the Rochester Code, and all the other codes that were ever enacted, and yet that will not bring a return to the unsatisfactory and fast decaying system that they are trying to save. Dr. Winter applied the principle of priority even in the polymorphic fungi, and his work was never rejected nor his system condemned. In phenogamic botany, the reform has been virtually accomplished, and those who have been using it for some years will hardly turn backward. As intimated above, we are assured of sufficient literature for the near future for the convenience of the botanists who are working in other lines than systematic botany; sufficient also to enable all the progressive teachers to teach and to put in the hands of their pupils and students a nomenclature that can not give them trouble in the future.—W. A. KELLERMAN, *Columbus, Ohio, Aug. 24th.*

NOTES AND NEWS.

LOUIS PASTEUR died at his home near St. Cloud, France, on Saturday, September 28th, in the seventy-third year of his age.

MR. GEO. MURRAY has been appointed custodian of the botanical department of the British Museum in place of Wm. Carruthers resigned.

PROF. L. M. UNDERWOOD has accepted the chair of biology in the Alabama Polytechnic Institute at Auburn. He has returned from his vacation in Europe, and has already entered upon his new duties.

THE DEATH OF C. C. BABINGTON, professor of botany in Cambridge University (Eng.) occurred July 22d. He was 86 years of age, and had not been botanically active for more than a score of years. By his death this important chair of botany is left vacant.

PROF. G. F. ATKINSON notes that *Podophyllum peltatum* is to be added to the list of plants having an open style canal leading into the cavity of the ovary. The canal is a very wide and shallow one appearing in cross section as a crescent-shaped or broadly V-shaped slit, which lies transversely to the placental line.

MEINSHAUSEN[1] has lately published a monograph of the genus *Sparganium*. He discusses the geographical distribution and gives several interesting instances of the local occurrence of various forms. Seventeen species are enumerated with diagnoses in Latin. The following are new to science: *S. splendens, simile, Glehnii, subvaginatum, flaccidum* and *pusillum*.—T. H.

[1] K. F. Meinshausen: Genre *Sparganium* L. Déscription systématique des espèces et leur distribution géographique d'aprés les observations faites au Gouvernement de St. Pétersbourg. Bull. de l'Acad. imp. d. sc. de St. Pétersbourg. N. S. **4**: 21–41.

THE STRUCTURE of a gall upon the stem of *Chondrilla juncea* is described by Gain.[1] The insect which produces it is a new species of Aulax, for which the author proposes the name of *A. Chondrillæ*. The larvæ were found in cavities formed in the pith, and it would appear that the lignified cellulose of this tissue furnishes the only nourishment for the parasite. The development of these galls did not injure the growth of the host. On the contrary the plant developed an abundance of sound achenes, and the galls seemed merely to have modified the ramification, each gall giving rise to five or even six lateral branches.—T. H.

IT SEEMS quite like "old times" for descriptions of new species from the Gray Herbarium to appear in *Am. Jour. Sci.* This last contribution is by Dr. Robinson and Mr. Greenman, and is in four parts: 1. "On the flora of the Galapagos Islands, as shown by the collection of Dr. G. Baur," an interesting discussion of the peculiar harmonic and divergent characters of the plants, with descriptions of new species; 2. "New or noteworthy plants, chiefly from Oaxaca," being a description of the numerous novelties of the recent collections of Pringle, Smith, and Nelson, among which are two new genera, *Oaxacania* (Compositæ), and *Urostephanus* (Asclepiadaceæ); 3. "A synoptic revision of the genus Lamourouxia" (twenty-six species); 4. "Miscellaneous new species."

BOTANY AND ZOOLOGY are becoming badly entangled again with "microscopy." As something that deals with methods, the latter has an important place; as dealing with botanical and zoological results it is out of its domain. At the last meeting of the American Microscopical Society, among the papers presented, the following titles suggest botanical rather than microscopical results: "Corky outgrowth of roots and their connection with respiration," H. Schrenk; "The chlorophyll bodies of Chara coronata," W. W. Rowlee; "Secondary thickenings of the rootstalks of Spathyema," Mary A. Nichols; "Two cases of intercellular spaces in vegetable embryos," K. M. Wiegand; "The fruits of the order Umbelliferæ," E. J. Durand; "The flagella of motile bacteria," V. A. Moore; "The fruits of the order Compositæ." W. W. Rowlee and K. M. Wiegand.

GEOSIRIS APHYLLA is a new plant of the family *Iridaceæ*, which has been discovered on Madagascar, where it grows on sandy soil in woods. Baillon[2] describes it and supposes that it is a saprophyte, since the plant has no green leaves. The parts under ground are unknown, and the aërial stem is simple or slightly ramified, reaching a height of about one decimeter. The leaves are reduced to short, ovate bracts, and the inflorescence is like that of our common *Iris*, only in a smaller scale. The perianth is white and has a strongly infundibuliform tubers. The plant has several characters in common with the Burmanniaceæ of Madagascar. The form of the anthers and the position of the stamens in alternation with the inner perianth-lobes does not, however, agree with the Burmanniaceæ but with the Iridaceæ. We have, therefore, in this plant a representative of the *Iridaceæ* with no green leaves.—T. H.

[1] E. Gain: Sur une galle du Chondrilla juncea L. Bull. de la soc. bot. de France. **41**: —. 1894.

[2] H Baillon, Une Iridacée sans matière verte. Bull. mens. de la soc. Linnéenne de Paris. no. 145. 1894.

At its recent meeting in Springfield, the Botanical Society of America decided to deposit donations to its library in the library of the Missouri Botanical Garden, St. Louis, where they will be accessible to members of the society and other botanists under the general rules of the garden library. Donations to the society's library should, therefore, be sent to the above address, plainly marked "for the Botanical Society of America."

Mr. F. Bœrgesen gives an enumeration of fresh-water Algæ from East-Greenland,[1] which is the more welcome, since the flora of that part of Greenland is almost unknown to us. About 100 species of *Desmidieæ* are enumerated, of which forty-one belong to the genus *Cosmarium*, and twenty-nine to *Staurastrum*. The *Myxophyceæ* are represented by fifteen genera with about thirty species. The most frequent were *Stigonema* and *Gloeocapsa*, which formed the main part of the black stripes on the rocks, so frequently observed in the landscape.—T. H.

Among the grants made by the A. A. A. S. for 1895–6 were the following in aid of biological subjects: for printing a second edition of the "Rules for citation," $5.00, for a research table at Woods Hole, $100.00, for publication of an international bibliography of zoology, $250.00. The Association table at Woods Hole has so far been occupied by zoölogists, and it was the feeling of many of the members in attendance at Springfield that it should go to the botanists next year, if suitable application were made. The committee consists of the vice-presidents of Sections F and G and the director of the laboratory: viz. Messrs. Theodore N. Gill, Washington, D. C., N. L. Britton, New York, N. Y., and C. O. Whitman, University of Chicago.

The presence of tendrils or clasping filaments in *Sepultaria Sumneriana* Cooke (*Peziza lanuginosa Sumneri* Berk. et Br.) has lately been observed by Boudier.[2] Filaments of this character have not been met with frequently among the fungi. Hyphæ or hairs more or less coiled have, however, been noticed in various genera. In the species of Sepultaria mentioned above, the author found that the mycelium or more properly the mycelium-like hairs, which cover the cupule like a woolly tomentum, bore small clumps which were formed by other filaments coiling around each other like the tendrils of the phanerogams. These were especially numerous when the fungus grew in a loose, gravelly soil, where the filaments had more space for their development, while they were scarcer when the fungus had grown in a stiff, compact soil. These peculiar tendrils develop from small tubercles and grow into small branches, simple or bifurcated, and which coil up as soon as they come in contact with other filaments. The filament which in this way becomes embraced by the cirrhus or tendril simply serves as a support, and no change was observed to take place in the protoplasm. In cases where the tendrils do not meet any of the neighboring filaments, they coil up around the same filament, from which they have developed. It is very likely that such tendrils may be met with in other species of Sepultaria, especially in those species, that grow in open, gravelly soil.—T. H.

[1] Færskvandsalger fra Ostgrœnland. Meddel. om Grœnland **17**: —. 1894.

[2] E. Boudier: Sur une nouvelle observation de présence de vrilles ou filaments cirroides préhenseurs chez les Champignons. Bull. de la soc. bot. de France **41**: —. 1894.

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Professor N. S. Shaler has a short article on "Domesticated Birds," giving an account of the development of turkeys, chickens, pigeons, etc., from their wild state to the present day, with many illustrations.

NOVEMBER.

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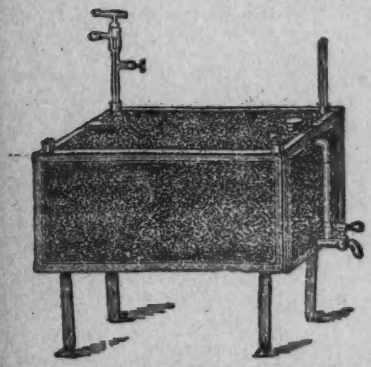

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